REMARKS

For the amendments above, Claims 1, 3, 4, 6, 7, and 10-12 have been amended to more particularly point out and distinctly claim Applicants' invention. The amendments therein are believed to overcome the rejection under 35 U.S.C. §112, second paragraph.

Claims 1-7, 10, and 12 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Nikitin et al., U.S. Patent No. 6,628,376 ("Nikitin") in view of Maule, U.S. Patent No. 5,415,842 ("Maule"), and Freischlad, U.S. Patent No. 5,185810 ("Freischlad"). The Examiner maintains that Nikitin shows an apparatus and method of examining biological, biochemical, and chemical characteristics of a medium comprising:

> a thick transparent substrate (14) with a planar surface on which a thin layer of conducting material (15) is deposited, onto which is placed the combination sample (16, 17) being investigated, on said thin layer of conducting material;
>
> a light source (10) linearly polarized in a predetermined direction whose light beam is reflected from said thin layer of conducting material from the side opposite to that on which the sample is placed at an angle substantially equal to that at which the interaction with the plasma resonance produces minimum reflectance intensity, the evanescent light field on the far side of the conducting film interacting with the sample, thus modifying the reflected light
>
> an interferometer which enables the reflected beam to be compared interferometrically with a reference beam derived from the same source, but not having had any interaction with the sample; and

an imaging means (20, 21) for recording an image of the planar surface in interference with the reference beam;

that Nikitin does not expressly say that the incident angle is which the plasma resonance is at maximum; that, however, Nikitin says that the incident angle is at (?) which the reflectance intensity is at a minimum and ideally at zero; that Maule shows a surface plasmon resonance device wherein Maule teaches that at the angle plasma resonance occurs, there is a dip in reflectance intensity; and that, therefore, from the teaching of Nikitin that the angel should be at a minimum reflectance intensity and from Maule's teaching that reflectance intensity drops with plasma resonance, one of ordinary skill in the art would conclude that the angle of incident should be at the angle at which maximum plasma resonance occurs.

The Examiner also maintains that Nikitin does not expressly show that the image is digitized and a processing means for processing said digitized image to provide an output image, although Nikitin shows an output image; that Freischlad shows a method for optical testing of samples comprising digitizer (10) for digitizing the interferometric image, a processor circuitry (11-25), and a display (26); and that at the time of the invention, one of ordinary skill in the art would have combined the apparatus of Nikitin with the apparatus of Freischlad to analyze the phase signals from the detectors and to display the data in order to characterize the sample.

The Examiner further maintains that for Claim 2, since the combination sample (16, 17) is placed on the conducting material, the combination sample is placed within up to about 3 wavelengths of the radiation being used for the investigation; that for Claims 3-6, Nikitin shows that the light source is a He-Ne laser and that it is polarized in the p-plane relative to the sample; that for Claim 7, the embodiment of Figure 2 is in a Mach-Zehnder arrangement; that for Claim 10, Nikitin shows a CCD (20); and that for Claim 12, Freischlad shows that the processor resolves for phase characteristics for each pixel using a known algorithm.

Claim 8 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Nikitin, Maule, and Freischlad as applied to Claim 1 above further in view of Batchelder et al., U.S. Patent No. 5,220,403 ("Batchelder"). The Examiner maintains that Nikitin shows the apparatus in a Mach-Zehnder interferometer arrangement but Nikitin, Maule, and King do not expressly show the apparatus in a Linnik interferometer arrangement; that Batchelder shows that phase changes on reflection from the sample cause changes in the resonance wavelength and that either Mach-Zehnder or Linnik interferometers can be used for microscopic examination of materials; and that at the time of the invention, one of ordinary skill in the art would have modified the Mach-Zehnder interferometer of Nikitin to have a different arrangement of a Linnik interferometer in order to use a system with a high aperture for better resolution images.

Claim 11 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Nikitin, Maule, and King as applied to Claim 1 above, and further in view of Eppinger, U.S. Patent No. 4,818,108 ("Eppinger"). The Examiner maintains that Nikitin, Maule, and King do not show the image being recorded on a permanent recording material; that Eppinger shows an interferometer where the image is recorded on either a CCD detector or a photographic film; and that at the time of the invention, one of ordinary skill in the art would have recorded the images of Nikitin, Maule, and King on a permanent recording material (photographic film) in order to obtain a permanent copy of the phase image that is easily portable and has a lower cost compared to a CCD detector.

Claim 13 has been rejected under 35 U.S.C §103(a) as being unpatentable over Nikitin in view of Maule and Freischlad. The Examiner maintains that Nikitin shows a method of examining biological, biochemical, and chemical characteristics of a medium comprising:

placing the sample (16, 17) being investigated onto a thin conducting material (15) which is deposited on a thick transparent substrate (14);

reflecting light beam linearly polarized in a predetermined direction from said thin layer of conducting material form the side opposite to that on which the sample is placed, at an angle substantially equal to that at which the interaction with the plasma resonance creates minimum reflectance intensity, the evanescent field of the far side of the layer of conducting material interacting with the sample, thus modifying the light;

interferometrically comparing said reflected beam with a reference beam derived from the same source, but not having any interaction with the sample; and

recording an image of a planar surface in interference with the reference beam;

that Nikitin does not expressly say that the incident angle is which the plasma resonance is at maximum; that, however, Nikitin says that the incident angle is at which the reflectance intensity is at a minimum and ideally at zero; that Maule shows a surface plasmon resonance device wherein Maule teaches that at the angle plasma resonance occurs, there is a dip in reflectance intensity; that, therefore, from the teaching of Nikitin that the angel should be at a minimum reflectance intensity and from Maule's teaching that reflectance intensity drops with plasma resonance, one of ordinary skill in the art would conclude that the angle of incident should be at the angle at which maximum plasma resonance occurs; that Nikitin also does not expressly show the digitizing and processing of the interference image; that Freischlad shows a method for optical testing of samples comprising digitizing the interferometric image, a processor circuitry and a display (26); and that at the time of the invention, one of ordinary skill in the art would have combined the method of Nikitin with the method of Freischlad to analyze the phase signals from the detectors in order to characterize the sample.

Applicants respectfully traverse the above rejections.

The invention herein is not suggested by Nitkitin, Maule, Freischlad, Batchelder, Eppinger, or any combination thereof. Nikitin's invention is not directed to producing an image of the sample surface in any of the embodiments. In Nikitin's Figures 2 and 3 there is no lens or other imaging system which produces an image of the light reflected from the thin layer of conducting material (15) on either the imaging means (20) or the photo-diode (21). These imaging detectors therefore receive a light distribution which is generally characteristic of all the illuminated region of the conducting film, and a specific pixel of the imaging detector does not correspond (is not conjugated to) a specific point or pixel on the conducting surface. This is the major difference between Nikitin and the present invention.

One of the embodiments of Nikitin, shown in his Figure 4, does indeed contain a lens (25), but the purpose of this lens is not to image the conducting film (15) onto the imaging detector (20). Rather, as shown in the figure and described in the text (Column 10, line 41, to Column 11, line 15), various points along the Θ -axis of the imaging detector (20) correspond to various angles of illumination Θ and not to positions of the conducting film. Likewise, various points along the orthogonal Δ-axis correspond to various phase differences Δ introduced by the plate (22) and not to positions on the conducting film. It follows that the mere existence of a lens in the system is insufficient for a person skilled in the art to know the purpose of that lens, in the absence of the specific teaching of the patent (which is lacking).

Since various angles of illumination Θ are included in the system of Nikitin (Figures 3 and 4), it is clear that the angle of incidence is not only that at which the reflected intensity is at a minimum, at which the maximum plasmon resonance occurs, but includes a range of angles around that minimum. Analysis of the data obtained with the invention of Nikitin using the complete range of Θ and Δ investigated gives a single average or representative value for the required characteristics of the examined specimen, at the time of the examination. It gives no information on spatial variations in the specimen characteristics.

In sum, Nikitin indeed provides an output image in one embodiment. However, as described above, points on this image do not have a one-to-one correspondence with points on the sample but, rather, with the angle of illumination Θ and phase shift Δ. The situation is significantly different from the present invention

Freischlad describes a specific algorithm which can be used for the analysis of the spatial image, as recited in Claim 12, "using a known algorithm". However, combination of this or any other algorithm with Nikitin's image will not provide the information to characterize spatial variation of plasmon resonance at points on the sample.

Batchelder discloses an invention with two microscope lenses forming an interferometer similar in concept to the Linnik interferometer. However, there is no element of surface plasmon resonance, and it is not restricted in any way to angles of incidence at or close to a resonance angle, nor to a specific polarization, but uses all polarizations and all angles of incidence up to the numerical aperture of the compound lens.

Maule describes an invention which, like Nikitin, does not produce a spatial image of the thin conducting film. Also, the addition of an imaging lens to the system is not in any way easy or obvious.

With regard to specific claims, such as Claims 1-7 and 10, Nikitin does indeed have the same elements (conducting film, He-Ne laser, Mach-Zehnder interferometer, CCD). However, in the present invention these elements are used for a significantly difference purpose, together with a lens or other imaging system which creates an image to indicate spatial variations on the sample. Applicants urge that the use of the CCD to record an interferometric image of the light reflected from the conducting film in each pixel, from which the phase in each pixel can be deduced algorithmically, is significantly different from Nikitin's patent and is not obvious.

With regard to Claim 8, only Batchelder describes a Linnik interferometer, since this interferometer indeed gives an image of the sample surface, which is not the intention of Nikitin or Maule, and therefore they would not see it as applicable to their system. Batchelder describes an imaging system, to which a Linnik type interferometer is applicable, but no surface plasmon resonance is involved or implied in his system, and it is urged that there is not straightforward connection.

With regard to Claim 11, any application involving CCD imaging means can also be carried out with photographic film or another permanent recording method, although with less convenience at the processing stage. This is not intrinsic to the invention, the important point being what is imaged, not how it is imaged. As described above, it is the imaging of the sample which is specific to the present invention.

With regard to Claim 12, there are many known algorithms for phase extraction from an interferogram, and no specific claim is made here to a specific algorithm.

With regard to Claim 13, the important difference between the present invention and the patents of Nikitin and Maule is again the fact that the claim refers to "..a method of measuring simultaneously the phase at each point of an image light reflected from a sample in which the phase has been modified by plasma resonance in a thin conducting layer." in each pixel of the sample can be deduced from the analysis. Freischlad refers to a specific method of interferogram analysis which would be included as a "known algorithm" in Claim 12.

Claim 9 has been indicated as containing allowable subject matter. The Examiner's attention is directed to new Claim 14, which comprises a combination of Claims 1 and 9.

Reconsideration and allowance of all the claims herein are respectfully requested.

Respectfully submitted,

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